15% from the average size, more usually by no more than 10%, and preferably by not more than about 5%. The uniform size, and therefore spacing, of the particles provides for a substantially uniform magnetic gradient throughout the matrix, and substantially uniform fluid flow characteristics.

[0079] In a preferred embodiment, the magnetic beads packed into the microchannel are coated with a materials as is generally described in U.S. Pat. No. 5,705,059. The coating materials include, but are not limited to, polymers such as plastic polymers, proteins, carbohydrates, organic molecules such as alkenes, etc. Coating is preferred in some embodiments because it helps to limit non-specific binding and to seal the spaces that might trap unwanted materials.

[0080] In a completed filled-channel, the selection of matrix and coating material will preferably result in channels or pathways through the matrix having an average diameter ranging from 1-100 μm and an occupying volume of about 60% to 80% of the total volume of the magnetic microchannel.

[0081] In a preferred embodiment, the magnetic beads in or on the walls of the magnetic microchannel are temporarily magnetic. For instance, they can be magnetized by an electromagnet and later demagnetized by reversing the polarity of the electromagnetic filed. By "electromagnet" herein is meant a mass, usually of soft iron, but sometimes of some other magnetic metal, such as nickel or cobalt, rendered temporarily magnetic by being placed within a coil of insulated wire through which a current of electricity is passing. The polarity of the electromagnet can be determined by controlling the direction of the electrical current in the wire. The electromagnet can be an integral part of the device, positioned at a convenient position proximal to the microchannel. Alternatively, the electromagnet can be a separate component from the device. The electromagnet should generally be positioned such that a field is produced perpendicular to the channel surface. The applied voltage can be any desired range to produce fields of about 0.1-1T.

[0082] In other preferred embodiments, the magnetic microchannel contains one or more gradient inducing features. By 'gradient inducing' feature herein is meant a physical feature that induces or enhances a magnetic gradient within the channel. Generally, any angled or curved feature will enhance or induce such a magnetic gradient. Accordingly, the gradient inducing feature may be a ridge, a sawtooth ridge, a dome, a step, a line, or any combination of these features. The slope and curvature of the gradient inducing feature is chosen based on the channel size, fabrication method, and desired gradient profile within the channel. In general, gradient inducing features of the present invention are between 1 μm and 1000 μm in height or diameter.

[0083] In a preferred embodiment, shown in **FIG. 5, a** cross-section of magnetic microchannel **32** is shown. It is noted that the device in **FIG. 5** may be formed in a variety of ways, as described herein. A plurality of layers may be bonded or adhered together, for example, or in other embodiments the device may be injected molded. In still other embodiments sacrificial materials may be used to form microchannel **32**. Although microchannel **32** is shown completely enclosed in **FIG. 5**, it is noted that all or any portion of magnetic microchannel **32** may be open. Magnetic microchannel **32** comprises a plurality of sawtooth ridges, including ridges **41**, **42**, **46**, and **48** as shown in **FIG. 5**. In another preferred embodiment, shown in **FIG. 6**, the magnetic microchannel comprises an array of dome structures, such as domes **52** and **54**. Although **FIGS. 5 and 6** depict features (ridges or domes) along only one side of the microchannel, it is to be understood that gradient-inducing features may be fabricated on any side of the channel, and in some embodiments, gradient-inducing features are formed on two, three, four, or any other number of sides of the microchannel, as appropriate.

[0084] The gradient inducing feature is generally fabricated from the channel material, preferably plastic polymer, or acrylic, as discussed above, and coated with a magnetic material. The sawtooth ridges in **FIG. 5** are coated with magnetic material **61**. Although a continuous layer of magnetic material **60** is shown in **FIG. 5**, it is to be understood that magnetic material **61** may not be continuous in other embodiments. That is, magnetic material **61** may be formed, for example, only at the tips of ridges **41**, **42**, and **46** in **FIG. 5**. In a preferred embodiment, magnetic material **61** coating is a nickel-iron alloy comprising about 80 percent nickel and 20 percent iron. The magnetic material may also comprise any high magnetic permeability material that can be plated-iron, nickel, cobalt or alloys thereof, etc.

[0085] While **FIGS. 5 and 6** show gradient inducing features only on one side of a microchannel, gradient inducing features may be placed on one or multiple sides of a channel. Further, gradient inducing features are preferably placed at an angle to the direction of fluid flow, particularly when the gradient inducing features are sharp features, such as sawtooth ridges. An area of low magnetic force may be present in the area between features. This effect is mediated by placing the features at an angle with respect to the fluid flow, or by filling the areas between features having low magnetic force with a non-magnetic material.

[0086] Gradient inducing features described above induce or enhance local useful magnetic field gradients, generally extending one half the diameter or height of the feature away from the feature. By 'useful magnetic field gradient' herein is meant a gradient of sufficient strength to influence an analyte of interest. Magnetic microchannels containing one or a plurality of gradient inducing features may be combined with one or more structures capable of generating a more global magnetic field gradient, that is a useful gradient that extends farther, in some embodiments up to distances on the order of millimeters. Suitable macro structures are described in U.S. Pat. Nos. 2,074,085; 6,241,894; and 6,013,188, all of which are expressly incorporated by reference herein.

[0087] In a preferred embodiment, the magnetic beads or magnetic materials coating gradient inducing features are permanently magnetized, for instance by a permanent magnet. Although less controllable, permanent magnet provides a cheaper and easier way of generating the magnetic field. The permanent magnet can either be an integral part of the device, or a separate component from the device. Preferably, the permanent magnet can be controlled by physically moving the magnet proximate or distal with respect to the magnetic microchannel.

[0088] Conveniently, the permanent magnet can be constructed of a commercially available alloy of neodinium/iron/boron. Other "off-the-shelf" magnets can also be used. Alternatively, the permanent magnet is carefully designed